

**IWAKI**

**Electromagnetic Metering Pump**

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**EH-E Type**

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**Instruction Manual**

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 Read this manual before use of product

Thank you for choosing an Iwaki's EH-E Series metering pump. This instruction manual deals with the correct installation, operation, maintenance, and troubleshooting procedures for the EH-E model metering pump. Please read through it carefully to ensure the optimum performance, safety and service of your pump.

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# Important Instruction

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## For the Safe and Correct Handling of the Pump

- Read the "Safety Instructions" sections carefully to prevent accidents involving your customers or other person and to avoid damage or loss of other assets. Always follow the instructions and advice found in these sections.
- Observe and abide by the instructions described in this manual. These instructions are very important for protecting pump users from dangerous conditions and situations related with the use of the pump system.
- The symbols relate to the following meanings described below.

 <b>Warning</b>	<b>Nonobservance or misapplication of the contents of the "Warning" section could lead to a serious accident, including death or injury.</b>
 <b>Caution</b>	<b>Nonobservance or misapplication of the contents of the "Caution" section could lead to serious physical injury to the user or serious damage to the product.</b>

### Types of Symbols



Indicates that "**Warning**" or "**Caution**" must be exercised. Inside this triangle, a concrete and practical image provided as a warning or caution message is depicted.



Indicates a prohibited action or procedure. Inside or near this circle, a concrete and practical image of the activity to be avoided is depicted.



Indicates an important action or procedure which must be performed or carried out without fail. Failure to follow the instructions herein can lead to malfunction or damage to the pump.

# Safety Section

## **Warning**

- **Turn off the power supply**

Working without disconnecting the power supply cause an electrical shock. Before engaging upon any working procedures involving the pump, make sure to turn the power supply switch off and to stop the pump and other related devices.



- **Terminate operation**

When you detect or become aware of a dangerous sign or abnormal condition during operation, terminate the operation immediately and start from the beginning again.



- **For specified application only**

The use of a pump in any application other than those clearly specified may result in injury or damage to the pump. Use the pump strictly in accordance with the pump specifications and application range.



- **No remodeling**

Never remodel a pump. Otherwise, a serious accident may result. Iwaki will not be responsible for any accident or damage of any kind which is caused by the user remodeling the pump without first obtaining permission or instructions from Iwaki.



- **Wear protectors**

If you touch or come in contact with any type of hazardous chemical liquid, including but not limited to chemicals, you may experience a serious injury. Wear protective gear (protective mask, gloves, etc.) during the pump operation.












- **Operating site must be free of water and humidity**








The pump is not designed to be water-proof or dust-proof. The use of the pump in places where water splashes or humidity is high may result in an electrical shock or short circuit.



# Safety Section

 <b>Caution</b>	
<ul style="list-style-type: none"> <li> <b>Qualified operators only</b>            The pump operator and pump operation supervisor must not allow any operators who have little or no knowledge of the pump to run and operate the pump. Pump operators must have a sound knowledge of the pump and its operation.         </li> </ul>	 Prohibited
<ul style="list-style-type: none"> <li> <b>Specified power only</b>            Do not operate the pump on voltage which is not specified on the nameplate. Failure to do so may result in damage or fire. Only the specified power level is to be applied.         </li> </ul>	 Prohibited
<ul style="list-style-type: none"> <li> <b>Do not run the pump dry</b>            Do not run the pump dry (without liquid inside the pump). Heat generated as a result of abrasion between elements inside the pump during operation without liquid may damage the inside of the pump.         </li> </ul>	 Prohibited
<ul style="list-style-type: none"> <li> <b>Do not wet or dampen</b>            If an electric part or wiring gets wet with the liquid spilled over accidentally, a fire or electrical shock may be caused. Install the system in a place free from liquid spillage or leakage.         </li> </ul>	 Do not wet or dampen
<ul style="list-style-type: none"> <li> <b>Ventilate</b>            Poisoning may result during an operation which involves, toxic or odorous liquid. Ventilate the operating site sufficiently.         </li> </ul>	 Caution
<ul style="list-style-type: none"> <li> <b>Spill-out accident</b>            Protective measures should be taken against any accidental spill-out or leakage of the operating liquid as a result of unexpected damage on the pump or the related piping.         </li> </ul>	 Caution
<ul style="list-style-type: none"> <li> <b>Damaged pump</b>            Never operate a damaged pump. A damaged pump may cause leakage or electrical shock.         </li> </ul>	 Prohibited
<ul style="list-style-type: none"> <li> <b>Do not damage or change power cable</b>            Do not scratch, damage, process, or pull the power cable forcibly. An extra load onto the cable, such as heating the cable or placing something heavy on the cable, may damage the cable and finally cause a fire or an electrical shock.         </li> </ul>	 Caution

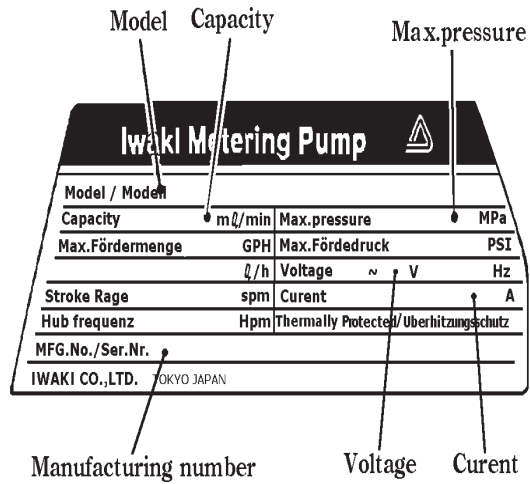
# Safety Section

 <b>Caution</b>	
<ul style="list-style-type: none"><li>● <b>Arrange grounding</b> Do not operate the pump without connecting the grounding wire. Otherwise, an electrical shock may result. Make sure the grounding wire is connected with grounding terminal.</li></ul>	 Grounding
<ul style="list-style-type: none"><li>● <b>Install an earth leakage breaker</b> The operation of a pump without using an earth leakage breaker may cause an electrical shock. Please install a leakage breaker in the system.</li></ul>	 Electrical Shock
<ul style="list-style-type: none"><li>● <b>Handling of power cable</b> Use of a defective or damaged power cable may result in a fire or electrical shock. Handle the power cable carefully.</li></ul>	 Electrical Shock
<ul style="list-style-type: none"><li>● <b>Follow the instruction manual</b> Replace the consumable part by following the descriptions in the instruction manual. Do not disassemble any part of the pump if the disassembling procedure for the part in question is not included in the instruction manual.</li></ul>	
<ul style="list-style-type: none"><li>● <b>Limited operating site and storage</b> Do not install or store the pump in the following places : Places where a flammable gas or material is used or stored. Places where the ambient temperature is extremely high (40 °C or higher) or extremely low (0 °C or lower).</li></ul>	 Prohibited
<ul style="list-style-type: none"><li>● <b>Disposal of used pump</b> Disposal of used or damaged pumps must be done in accordance with the relevant local law and regulations. (Consult a licensed industrial waste products disposing company.)</li></ul>	

# ***1. INTRODUCTION***

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# 1. Unpacking

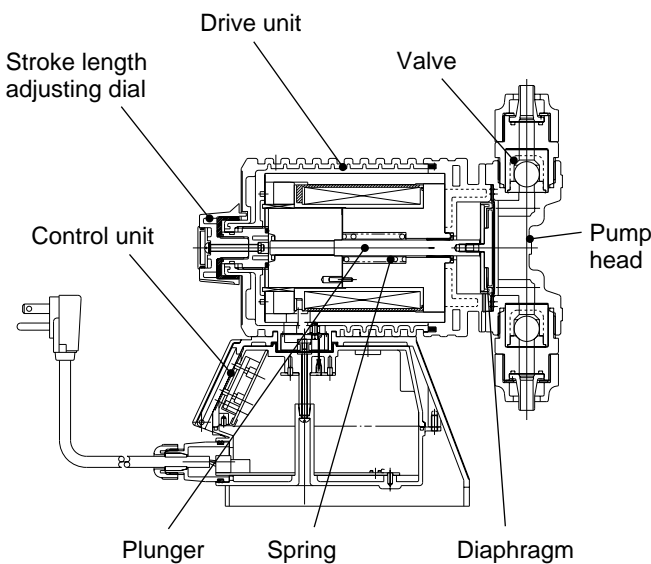


After unpacking the goods, check the following points to ascertain that the product is exactly as you ordered.

If you find anything wrong, please get in touch with your dealer.

- (1) Do the model, voltage, etc., shown on the nameplate represent what you ordered?
- (2) Has the goods been damaged in transit? Are the bolts and nuts loose?

# 2. Operation Principle



The EH Series electronic metering pump consists of a pump unit, a drive unit, and a control unit. The drive unit is an electromagnetic solenoid. When the solenoid coil is energized by the control unit the armature shaft moves forward due to the magnetic force of the solenoid. The shaft is attached to a PTFE faced diaphragm which is part of the pump unit. The diaphragm is forced into the pump head cavity decreasing volume and increasing pressure which forces liquid in the pump head out though the discharge check valves. When the solenoid coil is de-energized, a spring returns the armature to its starting position. This action pulls the diaphragm out of the head cavity increasing volume and decreasing pressure. Atmospheric pressure then pushes liquid from the supply tank through the suction check valves to refill the pump head.





(6) Power code

P	with plug
No symbol	without plug

(7) Controller E : E type

(8) Connection

Symbol	Applicable hose dia. (ID × OD)	Type
4	φ 8 × φ 13 (mm)	VC, V6, PC, VM
5	φ 9 × φ 12 (mm)	VC, V6, PC, VM
6	φ 10 × φ 12 (mm)	FC
8	φ 1/2" × φ 3/8" (inch)	VC, V6, PC, VM, FC
9	Rc 1/4"	SH
10	NPT 1/4"	SH
11	φ 10 × φ 16 (mm)	VC, V6, PC, VM
14	Rc 3/8"	SH
15	NPT 3/8"	SH

(9) Special configuration

01~99: Special material, special connection port diameter, etc.

● Controller identification

<b>EHC - 100 P E - **</b> (1)      (2)   (3) (4)   (5)					
(1)	Controller name		EH		
(2)	Voltage symbol	10 0 11 U 20 J 20 E 23 U	AC 100 V AC 110 V, AC 115 V AC 200 V AC 220 V, AC 230 V, AC 240 V AC 230 V	AC 90 ~ 126 V AC 90 ~ 126 V AC 180 ~ 220 V AC 198 ~ 264 V AC 207 ~ 253 V	50-60 Hz
(3)	Lead wire		P : with plug No symbol : without plug		
(4)	Controller		E		
(5)	Special configuration		0 ~ 99		

Points to be noted in handling

1. Do not detach the control unit unless unavoidable.
2. Never use the control unit with pumps having different symbols for driving unit and power source voltage specified on the control unit. (Check the nameplate.)

**⚠ Caution**

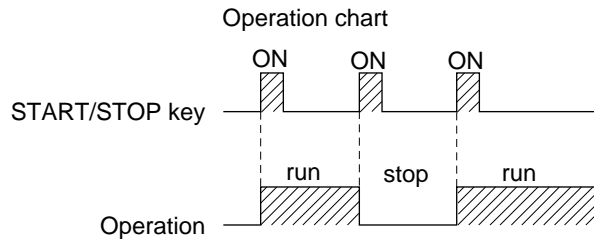
Operation with a pump having different symbols for driving unit and power source voltage other than those specified may cause failure or trouble in the electronic circuit of the control unit or the driving unit of the pump.



## 4. Operation Function

- Manual operation

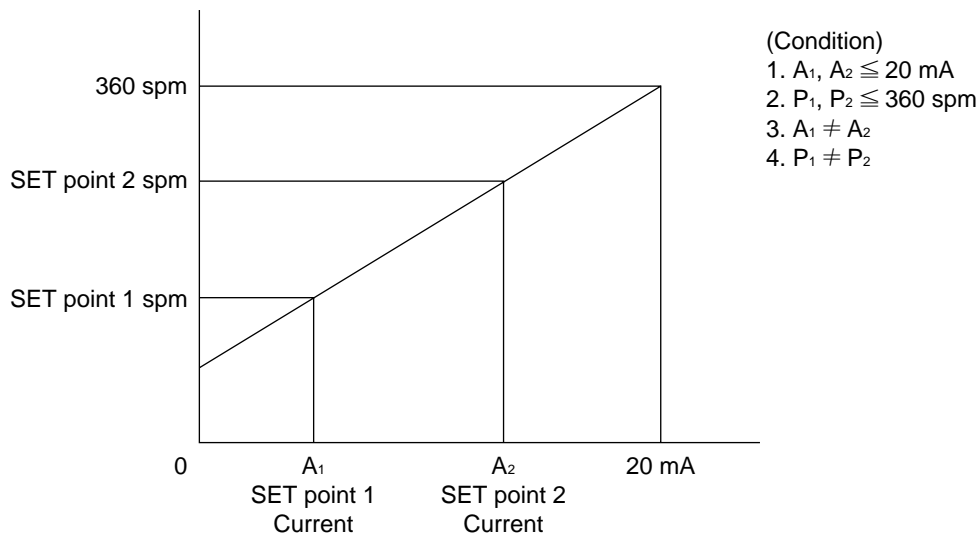
Stroke rate can be set from 0 to 360 spm with keys ▲ and ▼, and pump start and stop can be done with keys START/STOP. Both setting can be done while the pump stops or operates.



- Analog input operation (0 - 20 mA)

0 - 360 spm operation in proportion to 0 - 20 mA current input. Pump is fixed at 360 spm when came the input signal exceeding 360 spm.

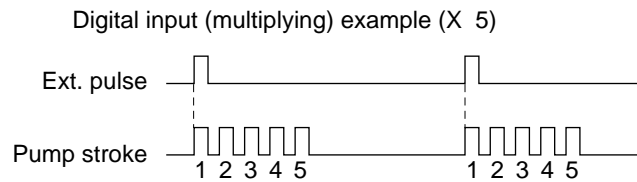
Straight line is automatically made by setting two points. So, the pump may not come to 0 spm even if 0 mA current comes.



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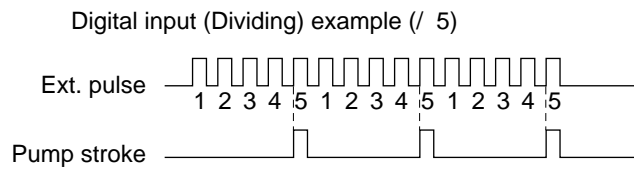
- Digital input (pulse multiply) operation

Pump makes strokes from 1 to 999 responding to external pulse signal. Stroke rate is the spm set for manual operation. The pulses which came while operation are put in memory up to 255 pulses. (It is possible to make the pulses not to be put in memory.)



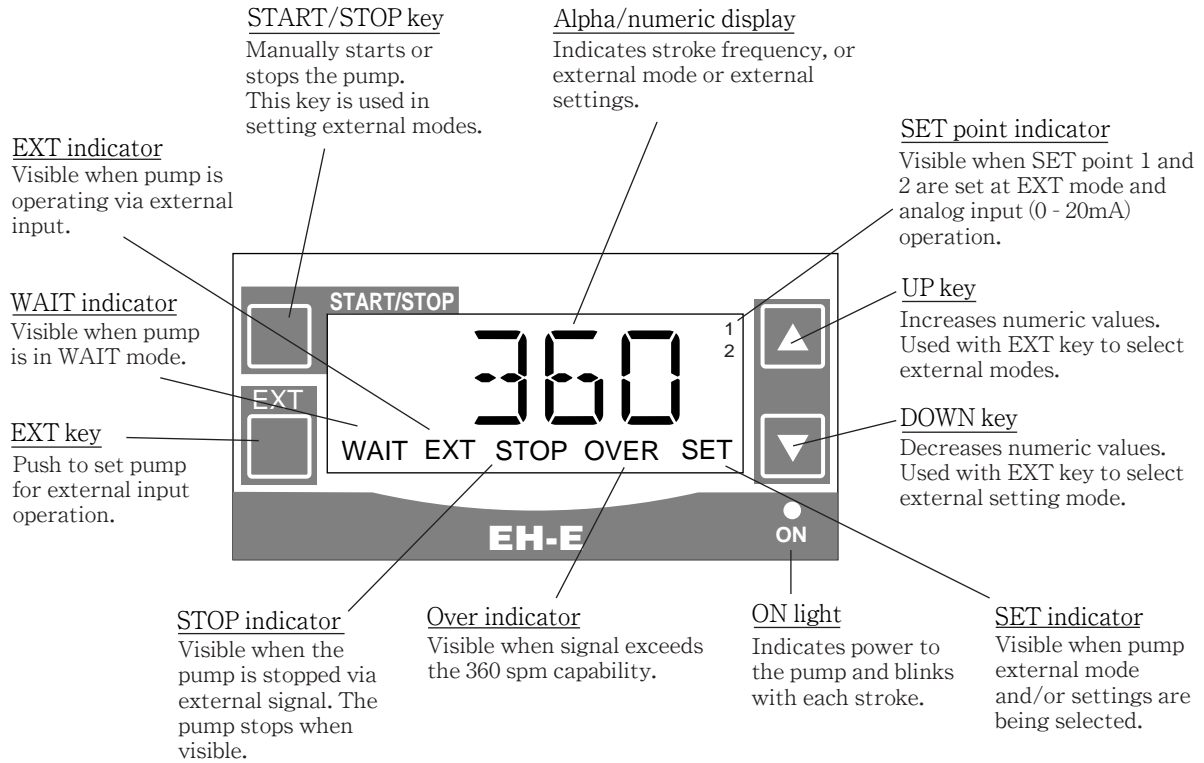
- Digital input (pulse dividing) operation

Pulse dividing operation by external pulse signals for 999 : 1 to 1 : 1. Stroke rate is the one set for manual operation. When the signals exceeding the set stroke rate came, excessive signals can be put in memory up to 255 pulses.








# 5. Controller Display

- Controller display and panel






- Basic display

Display examples	Meanings
	Running at manual operation mode. Value shows set spm.
	Waiting at WAIT mode. Displayed value is set value at manual operation mode.
	Running at EXT operation mode (Pulse multiply). Display shows running at 1 : 5 multiply.

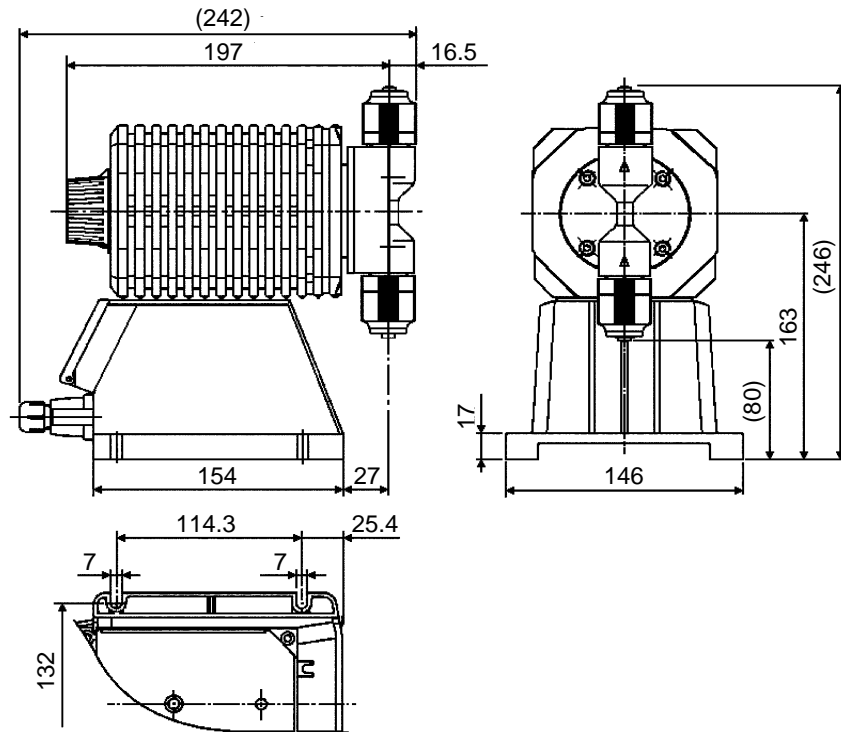
Display examples	Meanings
	Running at EXT operation mode (Dividing). Display shows running at 5:1 dividing.
	Running at EXT operation mode (Analog input 0 - 20 mA). Display shows running at 120 spm speed responding to input current.
  	In setting mode.

• Alarm display

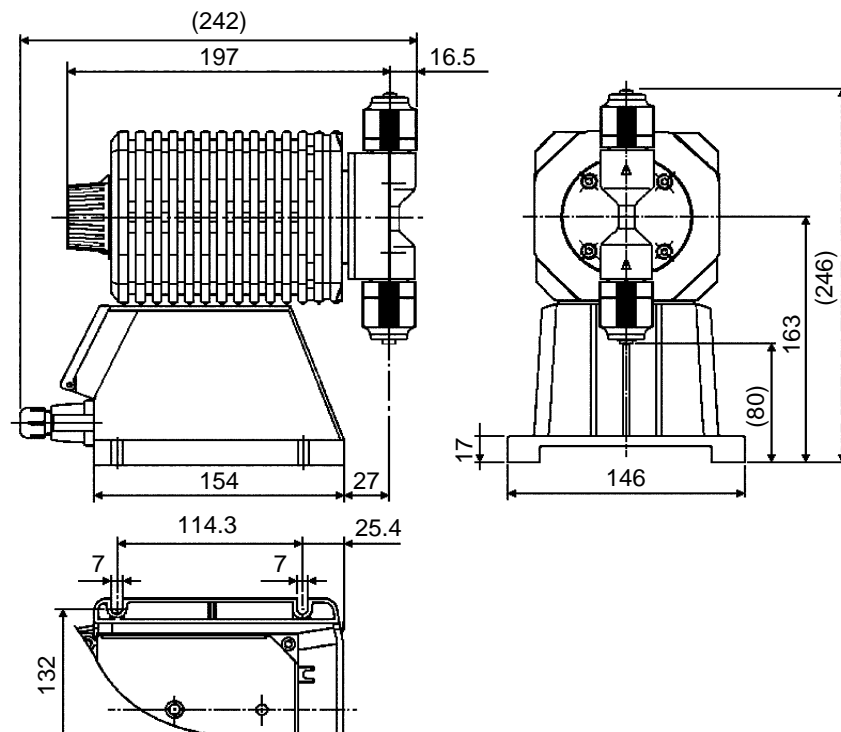
Display examples	Meanings
	Display for excess spm at EXT operation (analog input operation). In analog input operation, visible if external signal exceeding 360 spm operation comes. While visible, pump runs at fixed speed of 360 spm.
	Display for excess spm at EXT operation (Pulse multiply operation). In multiply operation, visible if next pulse comes when the pump is making the strokes. While visible, max. 255 pulses can be put in storage. You can set not to put them in storage.
	Display for excess spm at EXT operation (Pulse dividing operation). In dividing operation, visible if signal which exceeds max. preset number of strokes comes. While visible, the pump runs at fixed max. number of strokes. You can set so that excessive input pulses can be put in storage up to 255 pulses.

## 6. Dimensions (Material symbol: VC/V6/PC/VM/FC)

- EH-E30



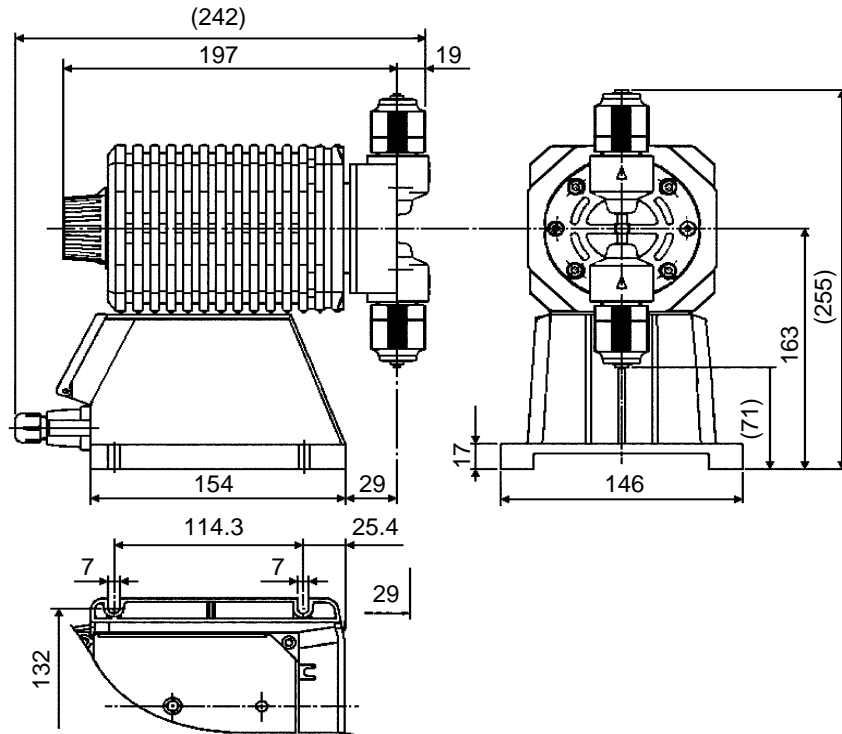
- EH-E35



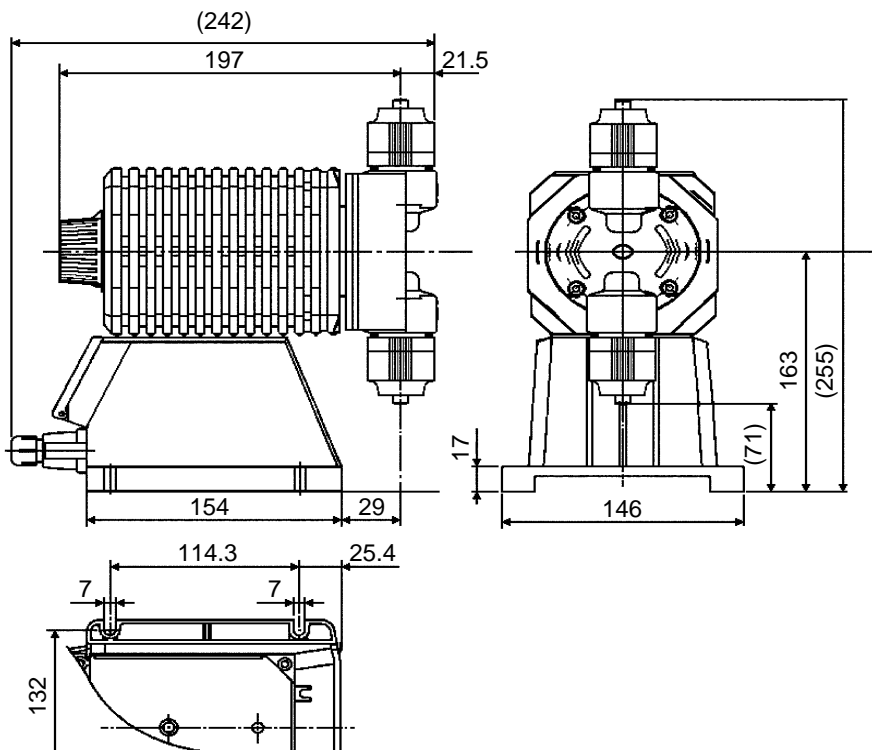


## 6. Dimensions (Material symbol: VC/V6/PC/VM/FC)

- EH-E45

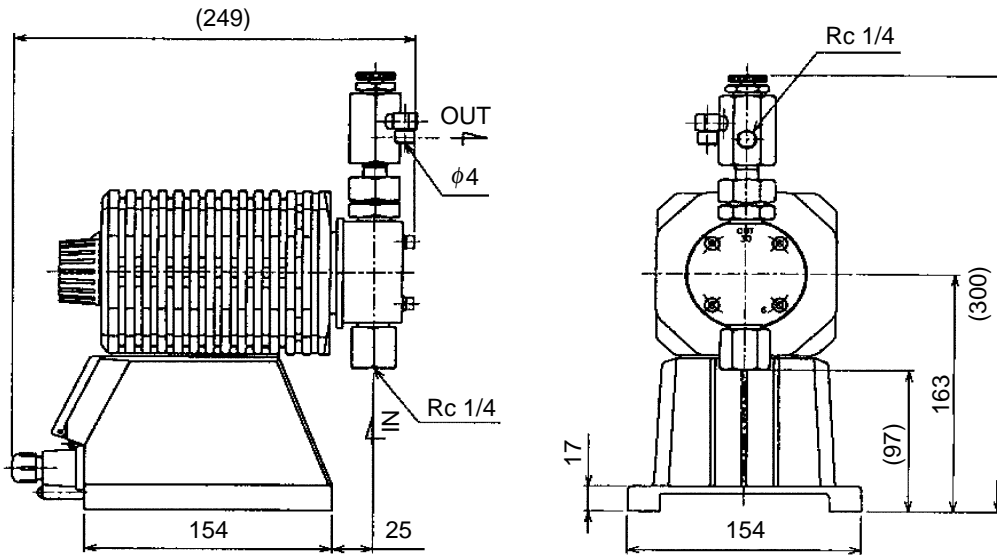


- EH-E55

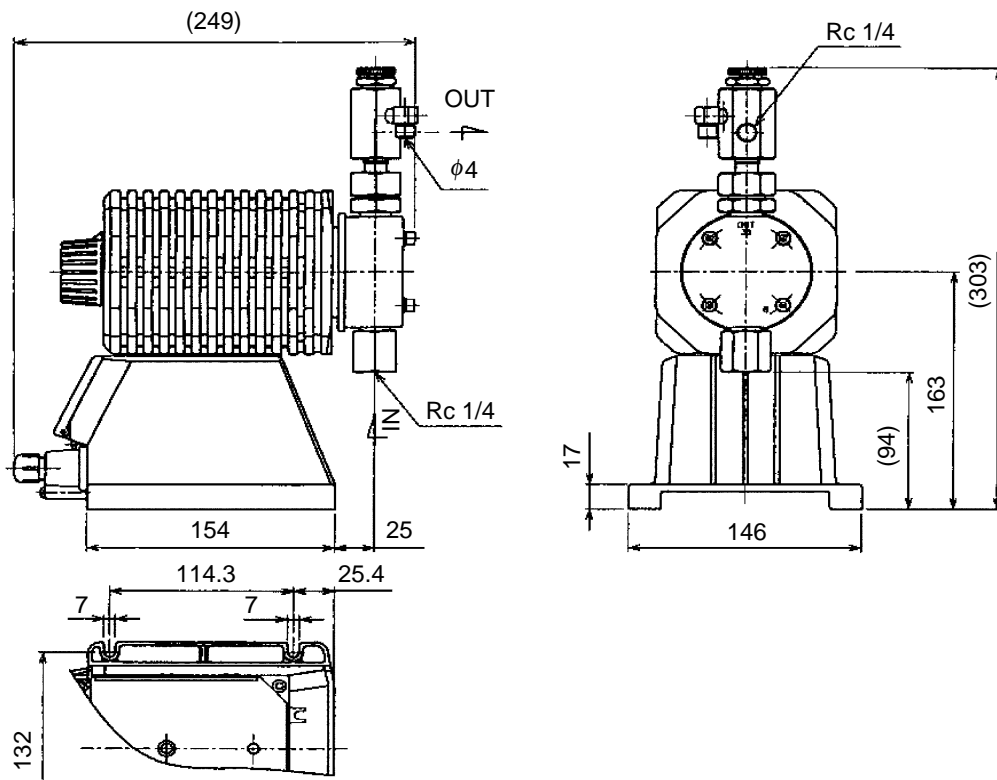


## 6. Dimensions (Material symbol: SH)

- EH-E30

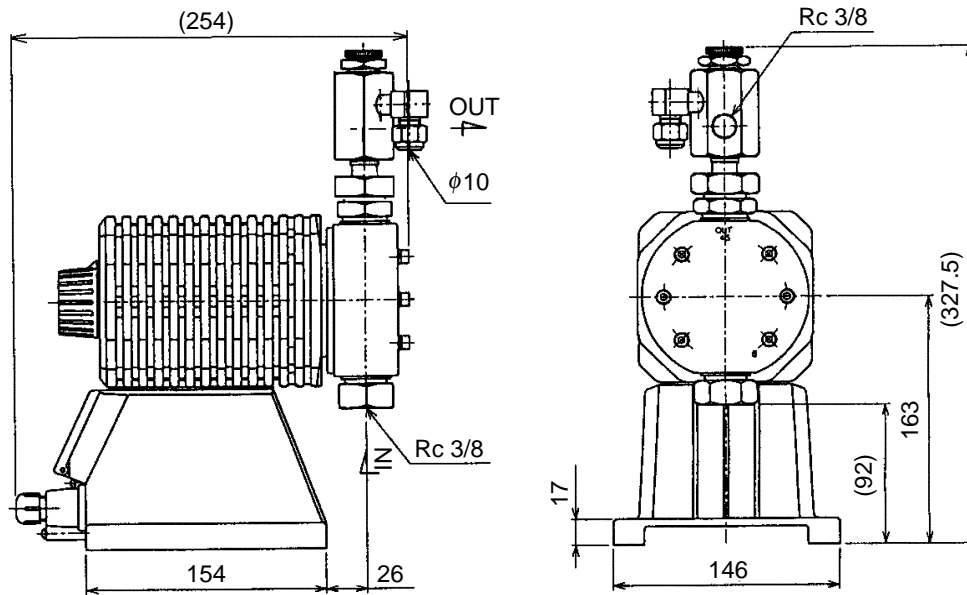


- EH-E35

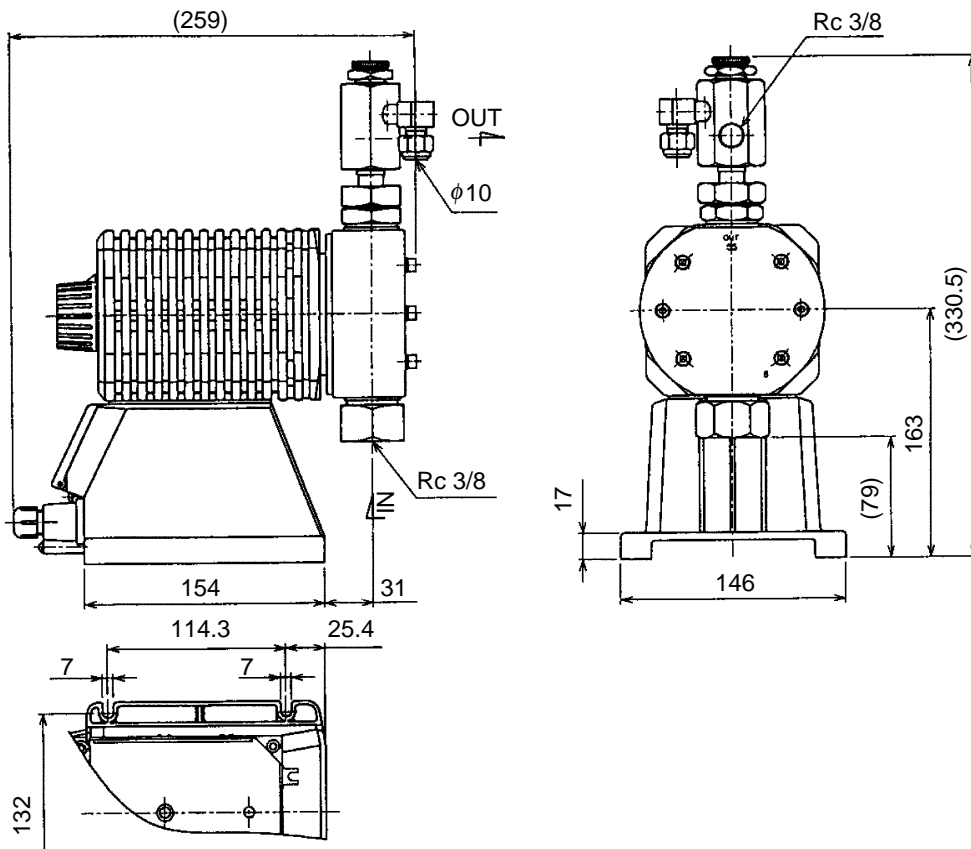


## 6. Dimensions (Material symbol: SH)

- EH-E45



- EH-E55



# ***2. INSTALLATION***

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# 1. Notes on Installation

Operators and maintenance service staff must read the instruction manual thoroughly before using the products. Do not operate the pump system unless all of the contents in the manual are completely understood.

## **Caution**

- **Turn off the power supply**

Working without disconnecting the power supply may cause an electrical shock.

Before engaging upon any working procedures involving the pump, make sure to turn the power supply switch off and to stop the pump and other related devices.

- **Terminate operation**

When you detect or become aware of a dangerous sign or abnormal condition during operation, terminate the operation immediately and start it from the beginning again.

- **Specified power only**

Do not operate the pump on voltage, which is not specified on the name plate.

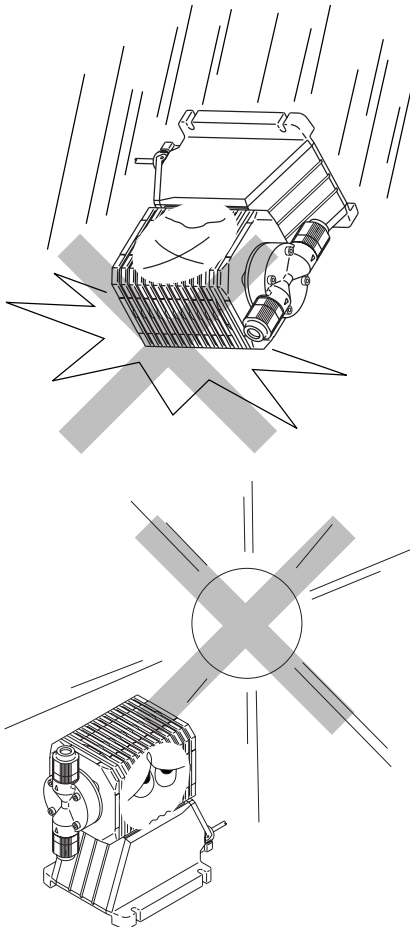
Failure to do so may result in damage or fire. Only the specified power level is to be applied.

- **Keep from heat or flame**

Do not place any dangerous materials or flammable objects near the pump for the prevention of fire or accident.

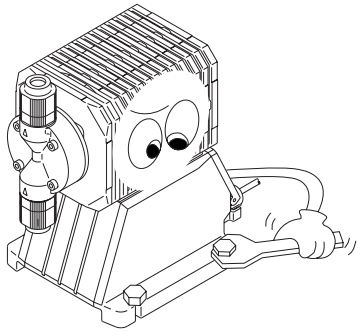
- **Damaged pump**

Never operate a damaged pump. A damaged pump may cause leakage or electrical shock.

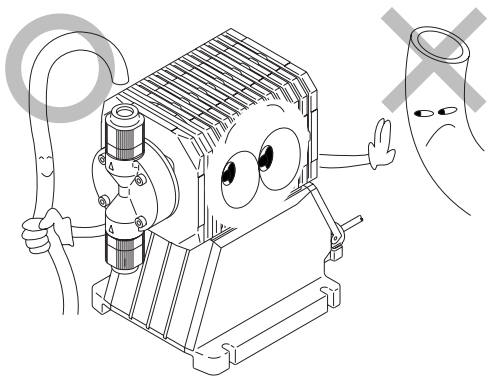


1. Dropping the pump or subjecting it to strong impacts may result in faulty performance. Handle the pump with care.

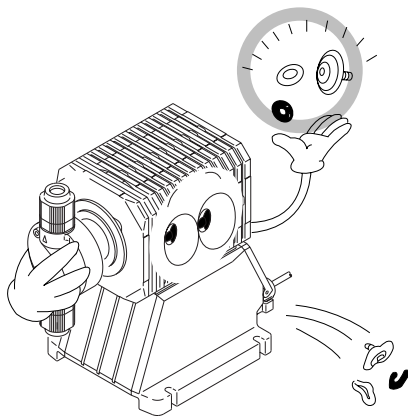
2. When installing the pump, avoid places exposed to direct sunlight or direct rain with an ambient temperature of above 40 °C, or with a relative humidity or above 90 %. Though the pump has a simple waterproof and dust proof structure, a sheltered location is recommended.



3. Install the pump at the place convenient for the maintenance/inspection works in the future. Securely fix the pump so that the pump can not vibrate horizontally.

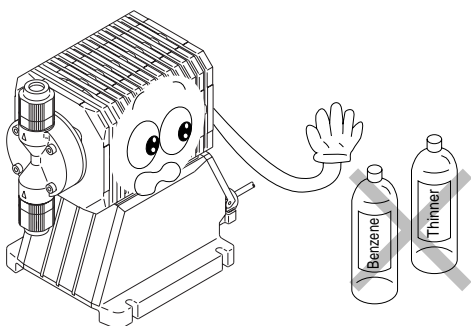


4. Use the tube corresponding to the pump suction and discharge port sizes. Securely connect the tube so that liquid can not leak or air can not be sucked in.



5. Make bleeding when you use the pump for the first time or when you replaced the chemical tank. Refer to item "Bleeding procedure" on page.

6. When you disassemble the pump head, replace diaphragm, O ring, valve gasket and valve unit by new ones.



7. Do not wipe the pump body with the cloth in which is soaked by solvent such as benzene, kerosene or thinner. Otherwise, the body may be discolored. To clean pump body, use dry cloth or the cloth in which are soaked by water or neutral detergent.

**⚠ Caution**

Liquid splash on driving unit and control unit may cause failure or accident. Pay attention the liquid not to be splashed.

## 2. Location

---

Choose a location for the pump which is clean, dry, close to an electrical outlet, and allows convenient access to stroke length control, frequency control, and tubing connections. Avoid areas where ambient temperature exceeds 40 °C or falls below 0 °C, or where the pump or tubing would be exposed to direct sunlight. Flooded suction (mounting the pump below the level of liquid in the supply tank) is strongly recommended, especially when pumping liquids that readily generate gas bubbles. Sodium hypochlorite and hydrogen peroxide are common examples of such liquids. (See Figure 1.)

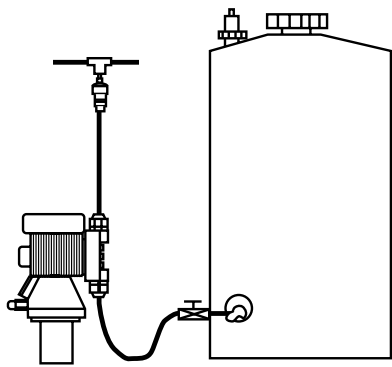


Figure 1  
Flooded Suction

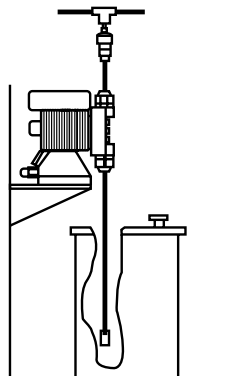


Figure 2  
Shelf Mount

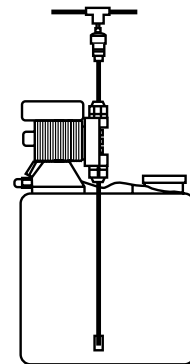
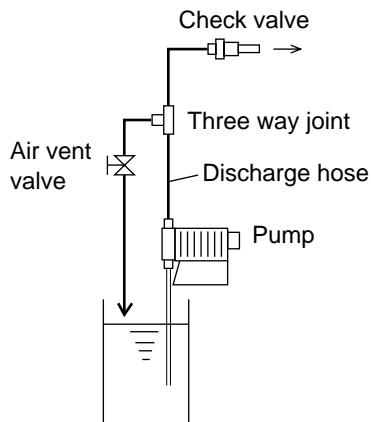
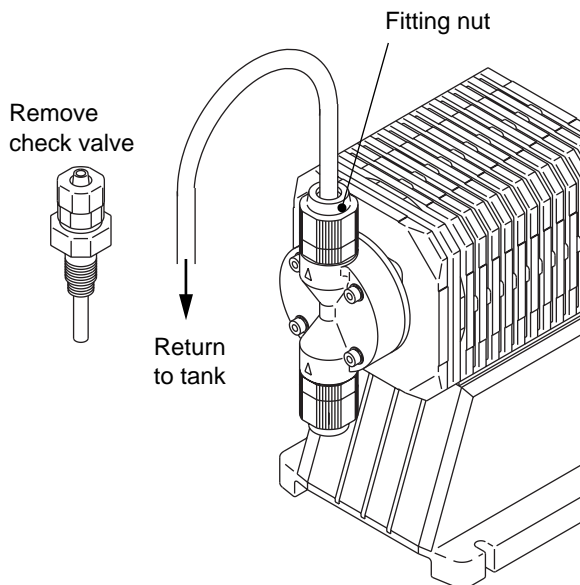
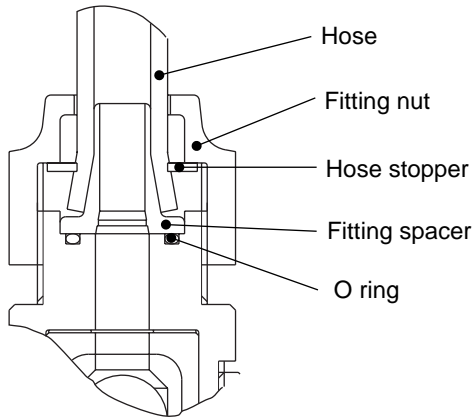


Figure 3  
Tank Mount

If flooded suction mounting is not possible, a shelf adjacent to (but not directly above) the supply tank often works well. (See Figure 2.) The supply tank or cover can also be used if it has provisions for mounting a pump. (See Figure 3.) In any case, the total suction lift should not exceed 1.0 m.

## 3. Tubing



### 1. Tubing for types VC, V6, PC, VM, FC

- Mount securely the tube with fitting nut, hose stopper and fitting spacer referring to the illustration on left.
- Pay attention not to tighten fitting nut excessively.

#### ⚠ Caution

- Use specified size of tube. Otherwise tube may come off. Refer to pump connection table on page 8 for the size of tube.
- Insert the fitting spacer into tube as deep as possible. Otherwise liquid may leak or tube may come off.
- Pay attention not to lose O ring. If O ring is not mounted, it may cause liquid leakage or failed self-priming.

### 2. Tubing for SH type

- Connections are Rc1/4 or NPT1/4 (EH-E30, 35SH) and Rc3/8 or NPT3/8 (EH-E45, 55SH). Apply seal tape to connected pipe and securely tighten it so that liquid can not leak nor air be sucked in.

### 3. Tubing for bleeding

- When you do bleeding, return the discharge side tube to the suction side tank. Remove the check valve if it is mounted. Refer to “1-1 Bleeding” on page 29.

#### ⚠ Caution

The EH-E pump is not equipped with built-in air-vent valve. Mount the air-vent valve referring to the illustration on left. Built-in type air-vent valve is available as an option for types VC, V6 and PC.



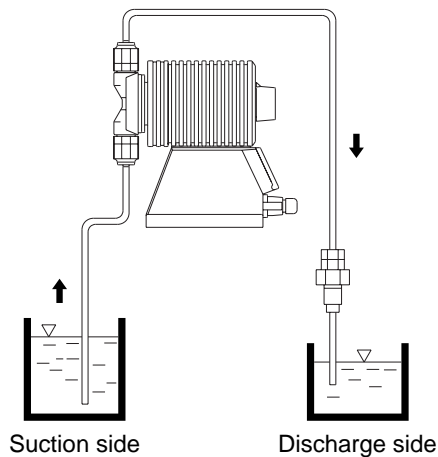


Fig. A

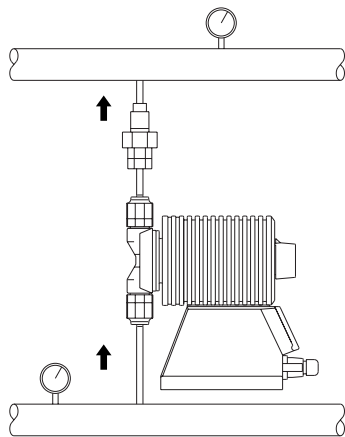


Fig. B

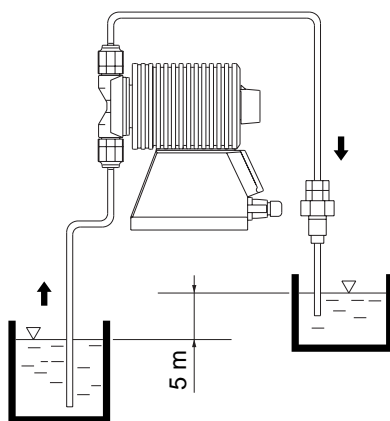


Fig. C

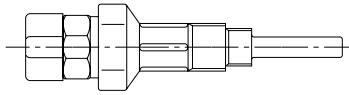
#### 4. Mounting check valve

In case the pump is installed as mentioned below, make sure to install the check valve to avoid over-feeding.

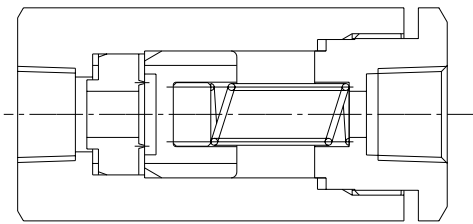
- 1) In case the suction side liquid level is higher than that of discharge side. (Fig. A)
- 2) In case the suction side pressure is higher than the discharge side one. (Fig. B)
- 3) In case the discharge side liquid level is higher than the suction side one but the height difference between the two levels is 5 meters or less. (Fig. C)
- 4) In case the pressure loaded to the pump (due to pipe resistance, discharge head etc.) is less than 0.13 MPa.

#### 5. Other precautions for tubing

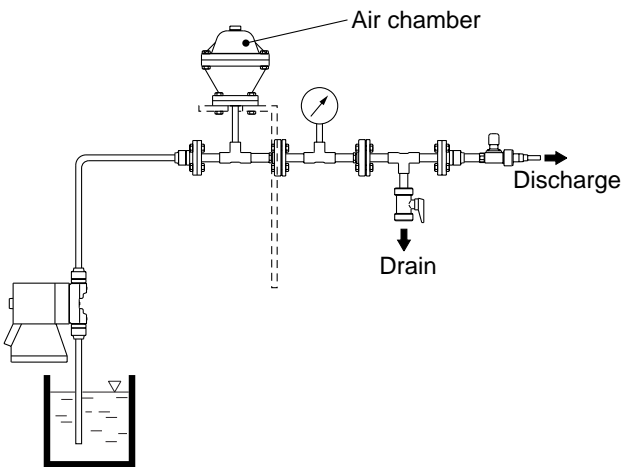
- 1) Use the specified size of tube. Otherwise required pump performance and flow rate may not be obtained.
- 2) Suction side tube should be as shorter as possible. (Max. length is 1 meter.)
- 3) Self-priming ability of this pump is 1 meter or less when the valves are dry.  
Install the pump of which the pump head to be 1 meter or less than the liquid level.
- 4) In case are handled gaseous liquids such as sodium hypochlorite or hydrogen peroxide etc., flooded suction is recommended for suction side. Flooded suction is effective to avoid gas generation or air pocket in the piping.



CA type check valve



CS type check valve



## 6. Precautions when mounting check valve

- 1) Install the check valve at the end of discharge tubing. It should be separated the pump by 1 meter or more.
- 2) CA type check valve can be connected to either tube or threaded pipe of R1/2 and R3/8.
- 3) Stainless steel check valve CS type has the connection of RC1/4 or NPT1/4 for pump models EH-E30 and 35SH, and RC3/8 or NPT3/8 for pump models EH-E45 and 55SH. For the connection of pipe, apply seal tape to avoid liquid leakage.

## 7. Install of accumulator or air chamber

To avoid the vibration caused by the pulsation of pump discharge side, install an accumulator or an air chamber in the piping.

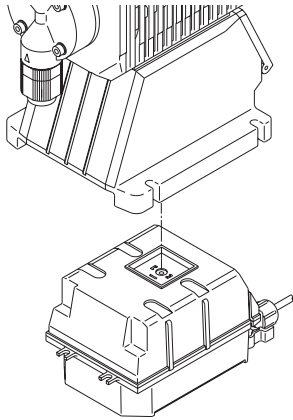
Vibration of pipe causes the rupture of pipe.

## 4. Electrical Wiring

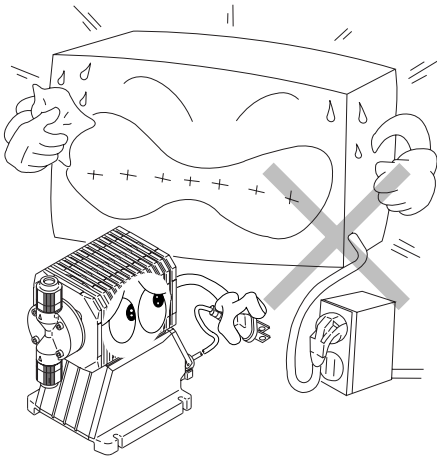
### 1. Precautions on wiring

#### **Caution**

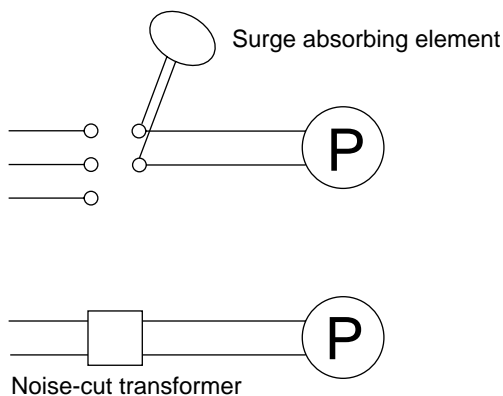
Only qualified operator/service staff should be in charge of the related electrical arrangement and control of the power source. Failure to observe this instruction may result in injury to person or damage to assets.



- 1) The control unit can be detached but do not detach it when unnecessary. Never combine the control unit with the driving unit which are different power voltages. Otherwise the electronic circuit or driving unit may be failed or damaged.



- 2) Never use in common the power source of the pump and that of high power electrical equipment which generates surge voltage. The surge voltage may cause the damage and failure of controller.



#### ● Surge voltage

The electronic circuit of the control unit may be affected by excessively high surge voltage. So, do not operate the pump near high-power electrical equipment of 220 V or above that generates high surge voltage.

Under unavoidable circumstances, take either of the following measures.

- (1) Use a surge absorbing element (such as a varistor with surge resistance of 2000A or more) at the pump power supply connection.
- (2) Use a noise-cut transformer.

## 2. Wiring

Power cord and external signal cord are connected according to the procedure as bellow.

### Caution

- Never do the wiring when pump is operating. Otherwise you will get an electric shock or the pump will be failed due to the short-circuit.
- Wait one minute or more after the power is switched off to start the wiring works because the internal circuit will be electrified just after it is switched off.
- Use the cord of which outer diameter is 7 or 8 mm. If smaller cord is used, enough tightness can not be obtained

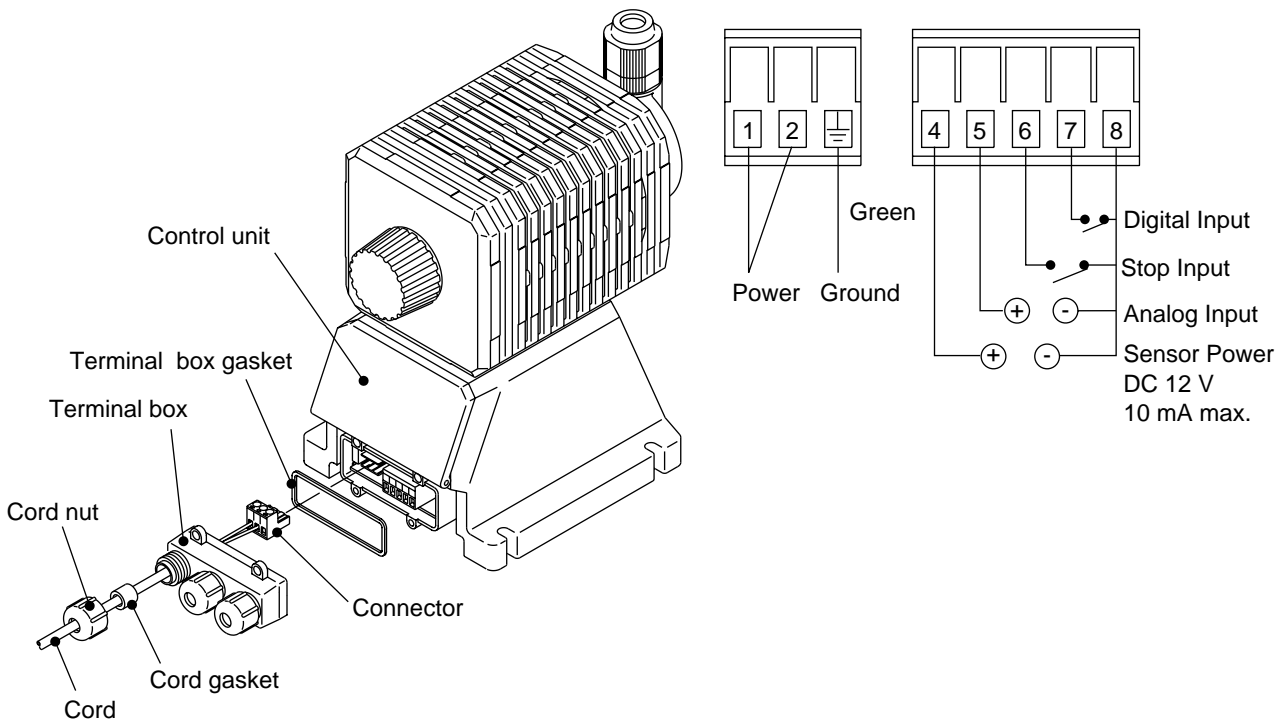
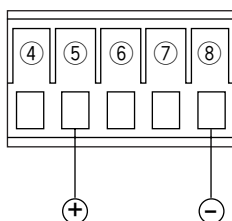


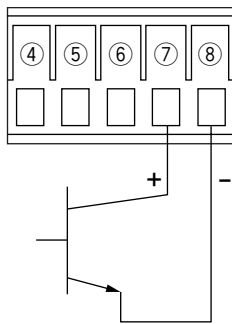
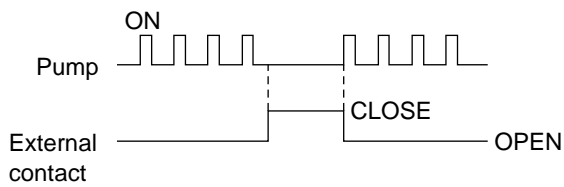
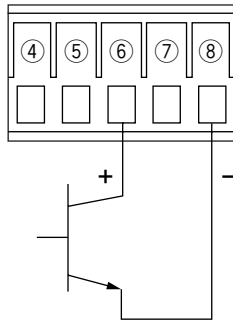
Fig. 5



#### ● Wiring for analog input operation

Analog input operation means the pump operation by input current signal of 0 to 20 mA to change the stroke rate in proportion to 0 to 360 spm.

For the wiring, connect the wires to the terminals ⑤ and ⑧ and fix them by screws. Tightening torque is 0.4 N·m or less. ⑤ is plus and ⑧ is minus. (Inside resistance : 250 Ohm)



● Wiring for stop function

Stop function means the method to provisionally stop the pump operation by external potential free contact signal or open collector signal.

For the wiring, connect the wires to ⑥ and ⑧ of the connector.

· When used with open collector

Pay attention to the polarity. ⑥ is plus and ⑧ is minus. (Max. chargeable voltage is 5 V, current 1.1 mA)

· When used with mechanical contact such as relay or so

Use the electronic purpose one of which the minimum applicable load of 1 mA or below.

● Wiring for pulse input function

Pulse input function means the pulse multiply or dividing operation by external potential free contact signal or open collector input.

For the wiring, connect the wires to ⑦ and ⑧ with screw driver. Tightening torque is approx. 0.4 N·m.

· When used with open collector

Pay attention to the polarity. ⑦ is plus and ⑧ is minus. (Max. chargeable voltage is 5 V, current 1.1 mA)

· When mechanical contact such as relay or so is used, use the one designed for electronic purpose of which the minimum applicable load of 1 mA or below.

# **3. OPERATION**

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# 1. Preparation for Operation

## Caution

- Do not operate the pump with discharge-side valve completely closed.  
Operating the pump with discharge-side valve fully closed may lead to liquid leakage or pipe rupture.
- Do not run pump dry.  
Dry operation of the pump over a long time (longer than 30 minutes) causes the pump to overheat and the pump unit (pump head, valve guide etc.) to become deformed or the pump head attachment to become loose, which may result in liquid leakage trouble.
- Keep the pump head firmly assembled.  
If mounting bolts on the pump head are loosened, liquid leakage may result.  
\* Fasten the 4 or 6 hex. socket bolts tightly before starting the initial pump operation. (The bolts may be loosened during storage or transportation of the pump, depending upon the condition.)  
\* Fastening torque: 2.6 N·m.  
Tighten all the bolts fully by applying an equal amount of torque in a diagonal order among the bolts.

## 1-1. Bleeding

Bleeding is a process to eliminate the air which residues in the suction tube or pump head.

Make sure to carry the bleeding prior to the initial operation of the pump or when the liquid in the tank was replaced or the pump rested for a long time.

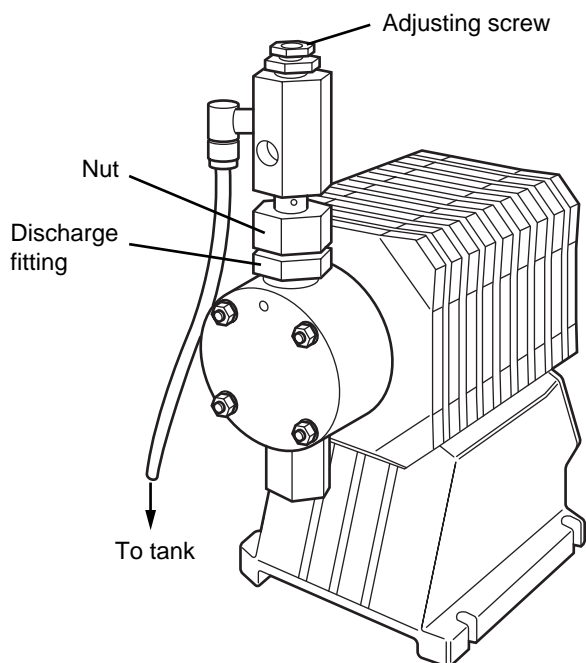
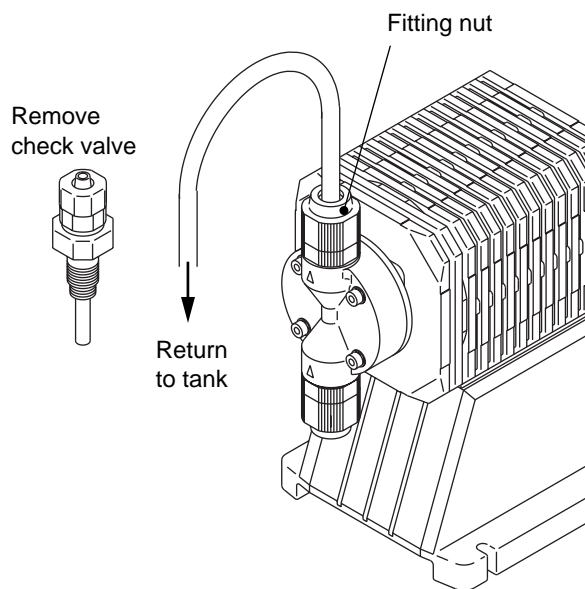


ON lamp



### Starting and stopping pump operation

- 1) Switch on the power and ON lamp (green)  
Lights and goes to WAIT mode after the word "V3.0E" was displayed. (When the pump is switched on for the first time.)  
The word WAIT is lit during WAIT mode.
- 2) Push START/STOP key one time. The word WAIT disappears and pump starts operation. Every time START/STOP key is pushed, operation and stopping is repeated.



#### Bleeding for types VC, V6, PC and FC

- 1) Return the discharge side hose to the tank and start the pump. Remove the check valve if it is mounted.
- 2) Run the pump for 10 minutes for bleeding.
- 3) When the air is removed and pump head is completely filled with liquid, return the discharge tube to the normal piping.
- 4) Check if no liquid leaks from any part.

#### Bleeding for SH (stainless steel head) type

Before the bleeding is done, tighten the nut and discharge fitting.

Tightening torque : E30, 35SH ... 5 N·m

E45, 55SH ... 7 N·m

- 1) Connect hose to bleeding hose connection part return the hose to the suction tank.
  - Bleeding hose should be open without any load.
  - Pay attention that the air and liquid come out together when bleeding is done.
- 2) Turn an adjusting screw counter clockwise. (by half to one turn)
- 3) Run the pump for ten minutes for bleeding.
- 4) Close the adjusting screw by turning it clockwise.
- 5) Check if no liquid leaks from any part.



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## 1-2. Adjustment of Discharge Capacity

Adjustment of the discharge capacity can be done by adjusting the stroke length and by adjusting the stroke rate but basically it is done by adjusting the stroke rate. Stroke length adjustment is an auxiliary way when the stroke rate adjustment is not enough.

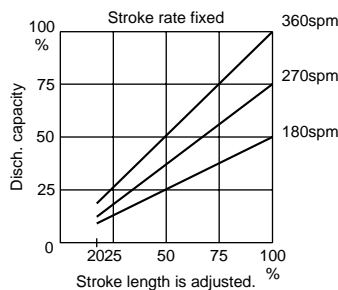
Pay attention to the followings for the correct adjustment.

- 1) For the gaseous liquid such as sodium hypochlorite and hydragine solution, set the stroke length at 100 % or near. Discharge flow may be reduced if the stroke length is short.
- 2) When the back pressure is high at discharge side, set the stroke length at 100 % or near.

### 1. Procedure to adjust the discharge capacity

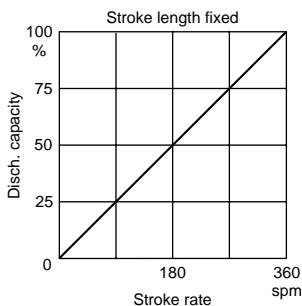
Appropriate stroke length and stroke rate are decided considering the pump operating condition and liquid characteristics or so. Following ways are recommended for proper calibration.

- (1) Set the stroke length at 100 % to roughly adjust the discharge capacity by adjusting the stroke rate.
- (2) Measure the discharge capacity.
- (3) If the measured capacity is below the wanted value, increase the stroke rate and measure again the discharge capacity.
- (4) Adjust the stroke length to do the fine adjustment of the capacity.
- (5) Measure again the discharge capacity to confirm the wanted capacity is discharged.



### 2. Adjustment of stroke rate

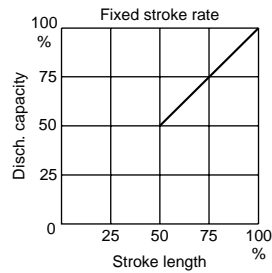
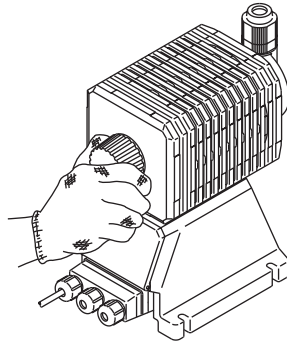
Stroke rate is adjusted by keys operation on the control unit. Stroke rate is adjusted from 1 to 360 spm.



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### 3. Adjustment of stroke length

- (1) Power on the pump to start and adjust the discharge capacity by turning the stroke length adjustment knob.
- (2) Figure below shows the relation between the stroke length and discharge capacity.  
Stroke length can be adjusted from 0 to 100 % but actually set the length between 50 and 100 %.



#### **⚠ Caution**

Do not turn the stroke length adjusting knob while pump stops.

#### **When the pump is stopped for a long period (more than 1 month)**

When the pump is stopped for a long period, clean the wet-end of pump and tubing by operating the pump with clean water for 30 minutes before stopping the pump.

When the pump is started after stopping, if it does not suck up and discharge the liquid, clean the valve set and remove foreign matters adhered. Do bleeding and adjust the discharge capacity.



### Notes to Overview Operating Scheme

- 1) -----> means automatic movement. After the program Ver is displayed, it automatically moves to the status at which the power was off last time. (When the pump is powered for the first time, it comes to WAIT mode.)
- 2) For the pump start by manual operation, push START/STOP key at WAIT mode. To stop the pump, push START/STOP key again.
- 3) EXT operation starts by pushing EXT key at WAIT mode and stops by pushing START/STOP key.
- 4) For the switching over between analog and digital operation, push EXT and ▲ keys simultaneously. Parameter is changed by ▲ and ▼ keys and the set value is fixed by START/STOP key.
- 5) To move to pulse memory switching mode, push EXT key while DIG is selected at analog/digital switching mode. (If ANA is selected, you can not come to this mode.)  
 Figures are changed by ▲ and ▼ keys and switching between multiply and dividing is done by EXT key.  
 Push START/STOP key to return to WAIT mode.

### Initial parameter value

When the pump is shipped from our factory, each parameter value is set as shown on table below.

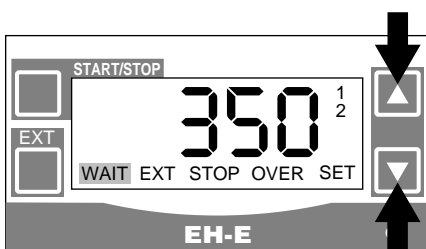
Mode	Parameter	Initial value	Setting range	Step	
Manual	spm	360	1 - 360	1	
A/D switching	Digital/Analog	dIG	DIG, ANA		
Pulse memory switching	Dividing	/OF	ON, OF		
	Multiply	× ON	ON, OF		
EXT operation	Dividing	/1	1 - 999	1	
	Multiply	× 1	1 - 999	1	
	Analog	Set point 1 Amp. : 4.0		0.0 - 20.0	0.1
		Set point 1 spm : 0		0 - 360	1
		Set point 2 Amp. : 20.0		0.0 - 20.0	0.1
		Set point 2 spm : 360		0 - 360	1

## 2-2. Setting and Operation of Controller

### ■ Manual operation

#### (1) Power ON

When the power is on, a green lamp lights up and the wording “V3.0E” appears, then the stroke rate for manual operation is displayed and comes to WAIT mode. (In case the pump is powered on for the first time.) If it does not come to WAIT mode, push once START/STOP key to come to WAIT mode.



#### (2) Stroke rate can be changed by pushing ▲ or ▼ key at wait mode or during operation. Push ▲ key to increase stroke rate and ▼ key to decrease. If you push the key in a short time, the spm figures changes slowly by one spm and if you continue to push over three seconds, they change quickly.

The pump is shipped set at 360 spm.

When the spm value is changed, the value is not put in memory unless you push START/STOP key or EXT key, or until three or more seconds have passed.



#### (3) Push START/STOP key to start the pump. WAIT word disappears and ON lamp blinks.



#### (4) Stop the pump.

When START/STOP key is pushed once, the pump stops and WAIT word appears to come to WAIT mode.

## ■ Automatic operation

### 1. Analog signal operation

#### (1) Power ON

When the power is on, a green lamp lights up and the wording “V3.0E” appears, then the stroke rate for manual operation is displayed and comes to WAIT mode. (In case the pump is powered on for the first time.) If it does not come to WAIT mode, push once START/STOP key to come to WAIT mode.



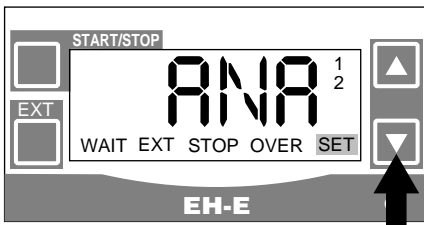
#### (2) Change over at EXT operation mode

Push EXT key and ▲ key simultaneously. Display shows “dIG” and SET lights. (If ANA is displayed, go to next item (3)).



The display changes to ANA if ▼ key is pushed.

(Every time ▼ key is pushed, the display changes ANA to dIG.) When the pump is shipped from the factory, it is set at dIG.



#### (3) Push START/STOP key to confirm the analog mode and move to WAIT mode.



#### (4) Value input at analog mode

Push EXT key and ▼ key simultaneously. Display shows the initial set value A04.0 and SET and 1 light.



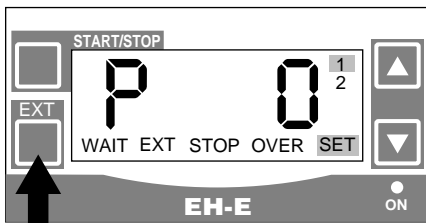
#### (5) Setting of input amperage at SET point 1.

Set the input amperage at SET point 1 by ▲ and ▼ keys. The value increases with ▲ key pushed and decreases with ▼ key pushed. Amperage changes slowly by 0.1 mA when the key is pushed briefly, and changes quickly if pushed 3 seconds or more.

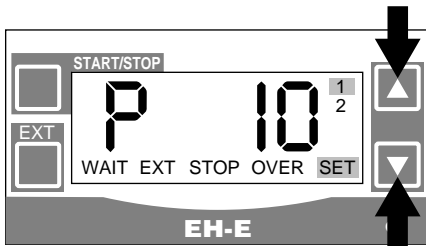
Setting range is 0.0 - 20.0 mA.

When the pump is shipped, it is set at 4.0 mA.





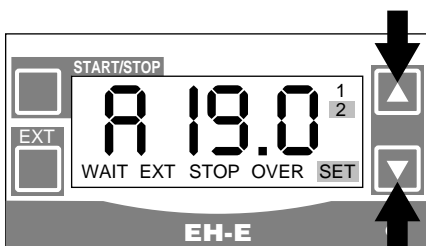
- (6) Push EXT key to confirm the value at SET point 1 and move to the setting of stroke rate for the current value of SET point 1. The words PO is displayed and SET and 1 light.



- (7) Setting of stroke rate for the current value at SET point 1  
Set the stroke rate for the current value at SET point 1 by ▲ and ▼ keys. Setting range is 0 - 360 spm. The pump is set at 0 spm when it is shipped from the factory.



- (8) Push EXT key to confirm the set current value at SET point 1 and move to the setting of the input current value at SET point 2.  
Display shows A20.0 and SET and 2 light.



- (9) Setting of current value at SET point 2  
Push ▲ and ▼ keys to set the current value at SET point 2. Do not set the value which is set at SET point 1.  
Set range is 0.00 - 20.00 mA.  
The pump is set at 20.00 mA when it is shipped from factory.



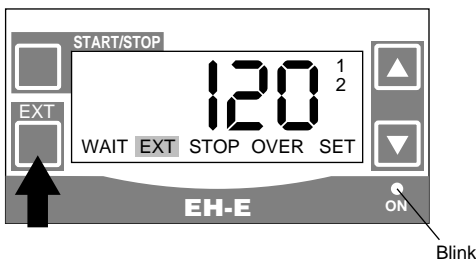
- (10) Push EXT key to confirm the set current value at point 2 and move to the setting of stroke rate vs current value of SET point 2. Display shows P360 and SET and 2 light.



- (11) Setting of stroke rate for the current value of SET point 2  
Push ▲ and ▼ keys to set the stroke rate for the current value at SET point 2. Do not set the value which is set for SET point 1.  
Set range is 0 - 360 spm.  
The pump is set at 360 spm when it is shipped.



- (12) Push START/STOP key to confirm the set value and move to WAIT mode.



- (13) Push EXT key to start the pump.  
 Pump operates according to the set current value. WAIT disappears and ON lamp blinks.  
 Display shows the stroke rate at which the pump operates and EXT word lights. Stroke rate changes corresponding to input current.  
 To stop the pump, push START/STOP key and WAIT word lights.  
 To start the pump next time, push EXT key.

#### Alarm indication



At the analog input operation, if the current exceeding 360 spm comes, the word OVER lights. While the OVER is lighting, the pump operates at 360 spm.



When analog input being set, if the same value (current or stroke rate) is put for SET point 1 and 2, ERR 1 is displayed for three seconds and then returns to set display.

## 2. Pulse multiply operation

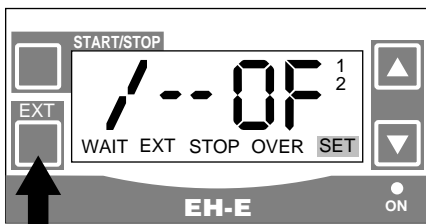


- (1) Power ON  
 Power on and green lamp lights, display shows "V3.0E" and then shows stroke rate of manual operation and goes to WAIT mode.  
 (In case the pump is powered for the first time)  
 The word WAIT is lit at WAIT mode. If it does not show WAIT, push START/STOP key once to change to WAIT mode.





- (2) Move to EXT operation mode.  
 Push ▲ key and EXT key simultaneously.  
 The word dIG is displayed and SET lights.  
 (If the word ANA is displayed, push ▼ key to change to dIG. Every time you push ▼ key, the words ANA and dIG switch over.) When the pump is shipped from the factory, it is set at dIG.



- (3) Move to pulse memory (The function to put in memory the pulses (max. 255 pulses) which come while the pump does the multiply operation.)  
 Push EXT key and /-- OF or / -- ON is displayed and SET lights. (If X -- ON or X -- OF is displayed, go to next (4). When the pump is shipped from the factory, it is set at / -- OF.



Push EXT key and the display changes to X -- ON or X -- OF. (Every time you push EXT key, / -- OF or / -- ON, X -- ON or X -- OF switches.) When the pump is shipped from the factory, it is set at X -- ON.



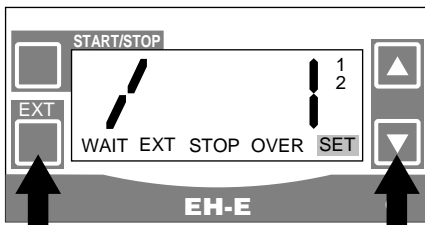
- (4) Setting of pulse memory ON, OFF  
 Push ▲ key and ▼ key to set ON and OFF of pulse memory. Display X -- ON is memory ON and X -- OF is memory OFF status.  
 When the pump is shipped from the factory, it is set at X -- ON.



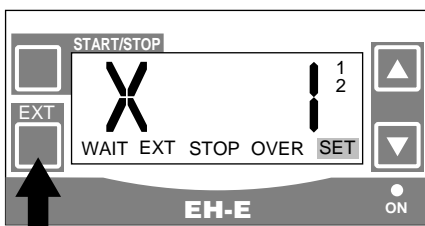
- (5) Push EXT key to confirm ON, OFF of pulse memory and return to EXT operation mode.  
 The display shows dIG and SET lights.



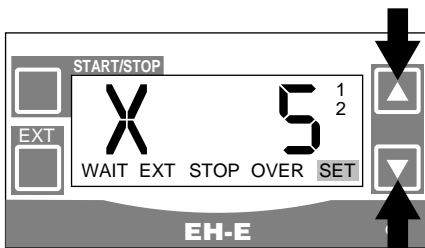
- (6) Push START/STOP key to confirm the digital mode and move to wait mode.



- (7) Switching of operation mode  
 Push EXT key and ▼ key simultaneously and / 1 (Dividing operation mode) is displayed and SET lights. (If X 1 is displayed, go to next (8)).



If you push EXT key, the display changes to X 1 (Multiplying operation). Every time EXT key is pushed, X 1 and / 1 are switched over.



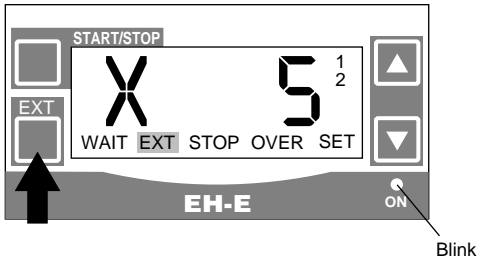
- (8) Setting of stroke number to be counted  
 Set the stroke number with ▲ key and ▼ key.  
 ▲ key increases the number and ▼ key decreases the number. The number changes slowly one by one if key is pushed in a short time and changes rapidly if pushed more than 3 seconds. Set range is 1 to 999. The pump is set at 1 when it is shipped from the factory.



- (9) Push START/STOP key to confirm the operation mode and stroke number.



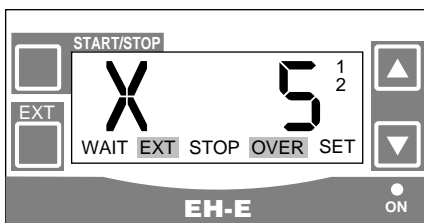
- (10) Setting of stroke rate  
 Stroke rate at multiply operation is the one which is set for manual operation mode. At WAIT mode, push ▲ key and ▼ key to set the stroke rate. Refer to the item of Manual Operation for details.  
 The pump is set at 360 spm when it is shipped from the factory.



- (11) Push EXT key to operate the pump.  
 Pump starts to operate, WAIT goes out and ON lamp blinks when a pulse comes.  
 The pump automatically stops after it operated for the stroke number which is set at above item (8). During the operation, the display shows pre-set stroke number and EXT lights. Push START/STOP key to stop the pump and go to WAIT mode. To start the pump again, push EXT key.

### Alarm indication

If next pulse comes during the multiplying operation, OVER lights. If the pulse memory is set to ON, max. 255 times pulse is put in memory and the pump continues operation.



### 3. Pulse dividing operation

- (1) Power ON  
 Power on and green lamp lights, display shows "V3.0E" and then shows stroke rate of manual operation and goes to WAIT mode.  
 (In case the pump is powered for the first time)  
 The word WAIT is lit at WAIT mode. If it does not show WAIT, push START/STOP key once to change to WAIT mode.



- (2) Move to EXT operation mode.  
 Push ▲ key and EXT key simultaneously.  
 The word dIG is displayed and SET lights.  
 (If the word ANA is displayed, push ▼ key to change to dIG. Every time you push ▼ key, the words ANA and dIG switch over.) When the pump is shipped from the factory, it is set at dIG.



- (3) Move to pulse memory (The function to memorize the pulses (max. 255 pulses) which come while the pump does the multiply operation.)

Push EXT key and / -- OF or / -- ON is displayed and SET lights. If X -- ON or X -- OF is displayed, push EXT key and the display changes to / -- ON or / -- OF. (Every time you push EXT key, / -- OF or / -- ON, X -- ON or X -- OF switches.) When the pump is shipped from the factory, it is set at X -- OF.



- (4) Setting of pulse memory ON, OFF

Push ▲ key and ▼ key to set ON and OFF of pulse memory. Display X -- ON shows the pulse memory ON and X -- OF shows memory OFF status.

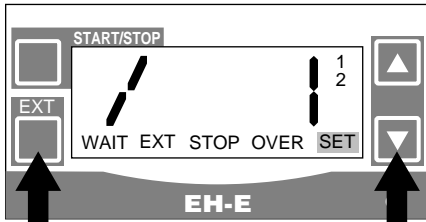
When the pump is shipped from the factory, it is set at / -- OF.



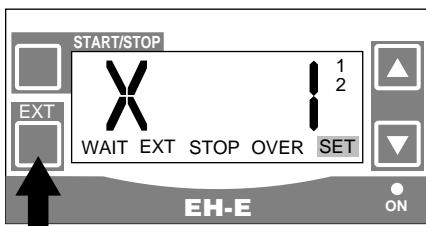
- (5) Push EXT key to confirm ON, OFF of pulse memory. The display shows dIG and SET lights.



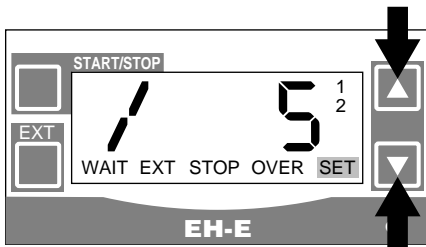
- (6) Push START/STOP key to confirm the digital mode and move to wait mode.



- (7) Switching of operation mode  
Push EXT key and ▼ key simultaneously, and / 1 (Pulse dividing operation mode) is displayed and SET lights.



If X1 (multiplying mode) is displayed, push EXT key to change to / 1.  
(Every time EXT key is pushed, the display changes from X1 to / 1.)



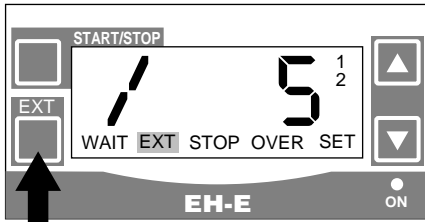
- (8) Setting of dividing ratio  
Set the dividing ratio with ▲ key and ▼ key.  
▲ key increases the number and ▼ key decreases the number. The number changes slowly one by one if key is pushed in a short time and changes rapidly if pushed more than 3 seconds. Set range is 1 to 999. The pump is set at 1 when it is shipped from the factory.



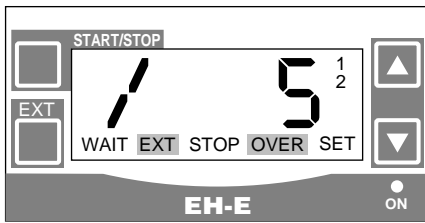
- (9) Push START/STOP key to confirm the operation mode and dividing ratio.



- (10) Setting of upper stroke rate  
Stroke rate at pulse dividing operation is the one which is set for manual operation mode. At WAIT mode, push ▲ key and ▼ key to set the stroke rate. Refer to the item of Manual Operation for details.  
The pump is set at 360 spm when it is shipped from the factory.



- (11) Push EXT key to start the pump. WAIT disappears and ON lamp blinks.  
 Dividing ratio is displayed and EXT lights.  
 Stop the pump, push START/STOP key to come to WAIT mode.  
 When the pump is started next time, push EXT key.



#### Alarm indication

If pulses which exceeds upper stroke rate come, OVER lights.  
 If the pulse memory is set at ON, max. 255 pulses input are put in memory and the pump continue to run.

# ***4. Maintenance***

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# 1. Maintenance

**Caution**



Before working on the pump, disconnect the power cord, depressurize the discharge tubing and drain or flush any residual liquid from the pump head and valves.

## 2. Diaphragm Replacement

Disconnect AC power to the pump and disconnect the suction tubing and discharge tubing. Remove the four head bolts with a 5 mm hex wrench. Turn the stroke length knob fully counter-clockwise. Unscrew the diaphragm and remove its retainer (small disk behind the diaphragm). Install the new retainer and diaphragm on the shaft. Turn the diaphragm clockwise until it bottoms on the shaft. Replace the pump head and tighten the head bolts to a torque of 2.6 N·m.

## 3. Valve Replacement

Remove the suction and discharge tubing. Remove the suction fitting, two valve cartridges, o-ring and gasket (s). Install the new o-ring, gasket (s) and valve cartridges.

Be sure both valve seats are in the same orientation. Refer to Figure 6, below. Tighten the suction fitting. Similarly remove and replace the discharge valve cartridges, o-ring and gasket (s).

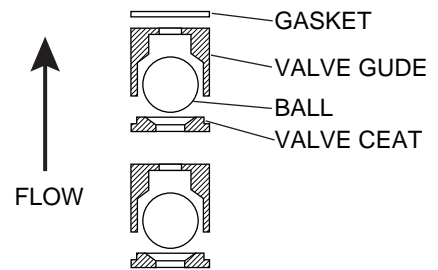


Figure 6  
Valve Cartridge Orientation

## 4. Tubing

Check ends of tubing for splits, cracks, or thin spots. Examine the full length of tubing for damage due to chafing, abrasion, stress cracks, excessive temperature or exposure to ultraviolet light (direct sunlight or mercury vapor lamps). If any signs of deterioration exist, replace the entire length of tubing. It is a good idea to replace discharge tubing on a regular preventive maintenance schedule every 12 months.

## 5. Consumable parts

	Part	Qty.	Replacement Timing
Valve set	 (Refer to pages 47 and 48)	2 sets	Approx. 8,000 hrs.
Diaphragm		1	

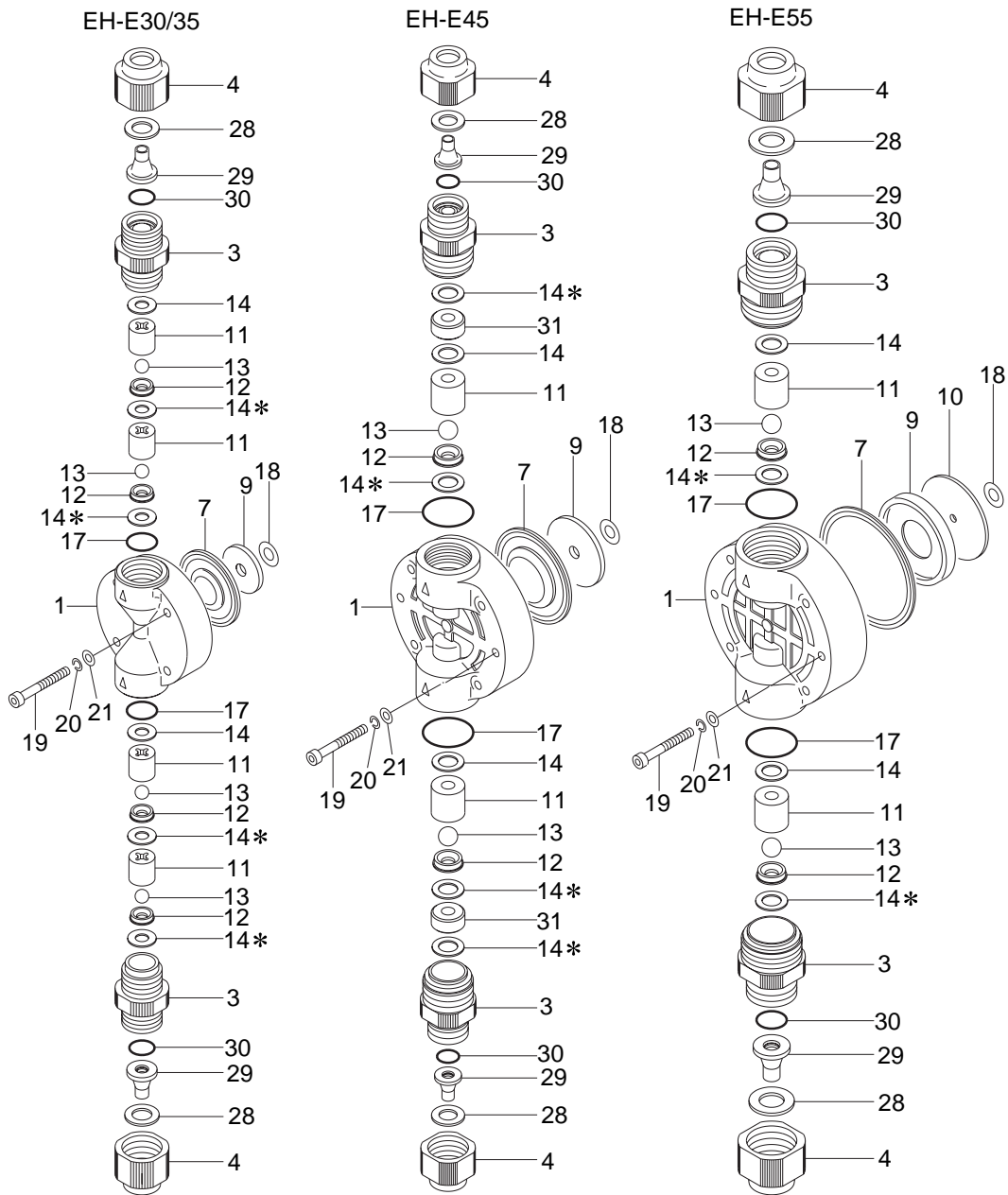
The durability of expendable parts depends on the pressure, temperature, and properties of the liquid handled. The value in the above table is obtained from a continuous run of the pump using clean water at ambient temperature. Take the value as a guideline for replacement.

The valve set illustrated above represents VC, V6, PC and VM types of E30 & E35. For composition of valve set of all other types, refer to next item "Names of parts and Structures" on pages 47 and 48.



# 6. Names of Part and Structure

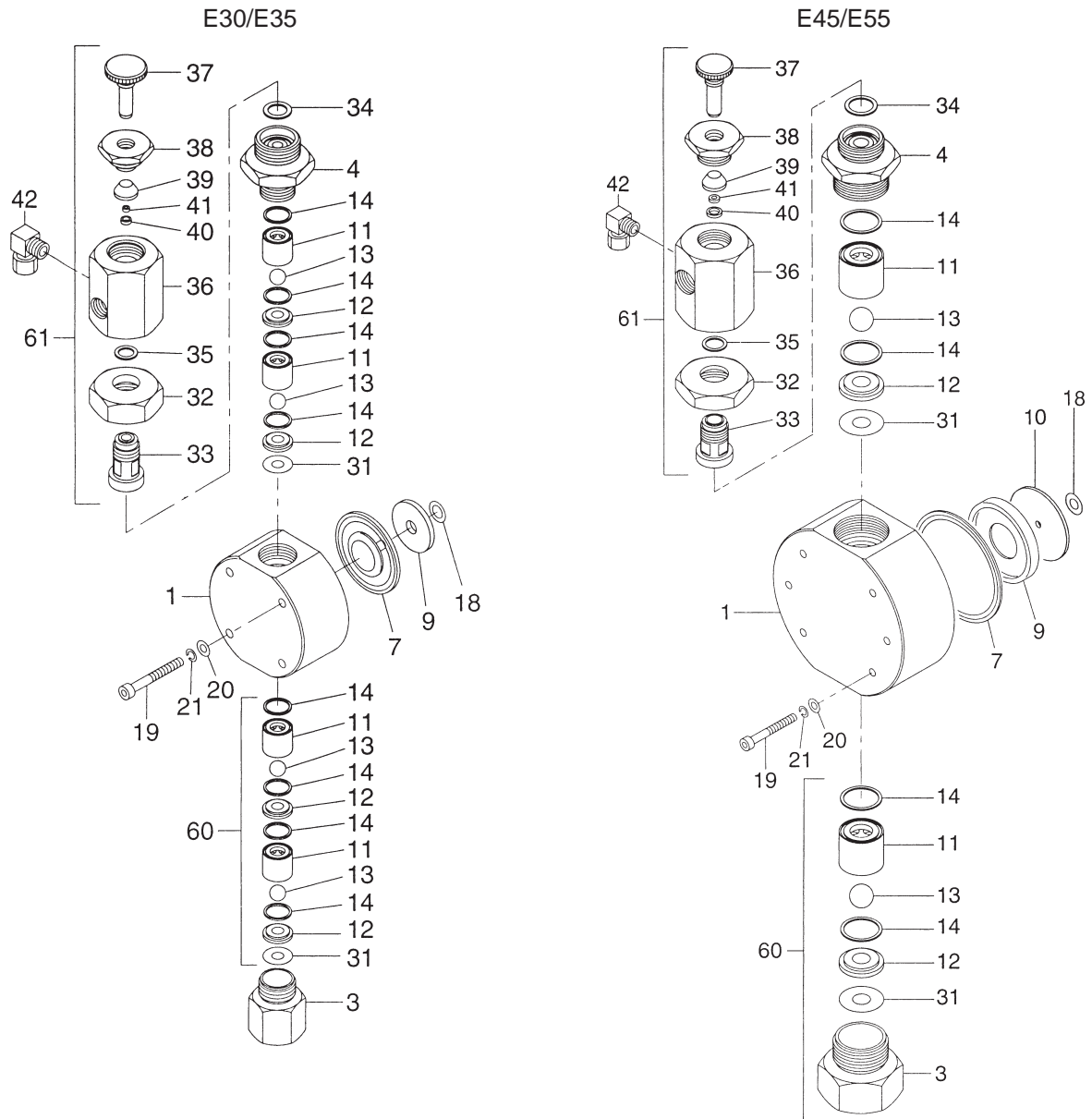
(1) Pump Head Unit (Material symbol: VC/V6/PC/P6/VM/FC)



No.	Parts name for types VC/V6/PC/VM/FC	Q'ty	No.	Parts name for types VC/V6/PC/VM/FC	Q'ty
1	Pump head	1	17	O-ring (Gasket for type FC)	2
3	Fitting	2	18	Diaphragm spacer (Note 4)	1
4	Fitting nut	2	19	Hex. sock. cap bolt (Note 2)	4 (6)
7	Diaphragm	1	20	Plain washer (Note 2)	4 (6)
9	Retainer	1	21	Spring washer (Note 2)	4 (6)
10	Back up retainer (Note 1)	1	28	Hose stopper	2
11	Valve guide (Note 2)	4 (2)	29	Fitting spacer	2
12	Valve seat (Note 2)	4 (2)	30	O-ring (Gasket for type FC)	2
13	Valve (Note 2)	4 (2)	31	Spacer	2
14	Valve gasket (Note 3)	(Note 5)			

Note 1: For type E55 only.  
 2: ( ) is for E45 & E55.  
 3: Valve gasket maked "14\*" is for FC type.  
 4: Two or more spacers may be put depending on shipped pumps.  
 5: 2 pcs for types VC/V6/PC/VM and 6 pcs for type FC.

(2) Pump Head Unit (Material symbol: SH)



No.	Parts name for type SH	Q'ty	No.	Parts name for type SH	Q'ty
1	Pump head	1	21	Spring washer	4 (6)
3	Suction fitting	1	31	Gasket	2
4	Discharge fitting	1	32	Nut	1
7	Diaphragm	1	33	Fitting	1
9	Retainer	1	34	Fitting gasket	1
10	Back up retainer (Note 1)	1	35	Air vent gasket	1
11	Valve guide (Note 2)	4 (2)	36	Air vent body	1
12	Valve seat (Note 2)	4 (2)	37	Adjusting screw	1
13	Valve (Note 2)	4 (2)	38	Seal nut	1
14	Valve gasket (Note 2)	8 (4)	39	Seal ring	1
18	Diaphragm spacer (Note 3)	1	40	Seat	1
19	Hex. sock. cap bolt	4 (6)	41	Seat ring	1
20	Plain washer	4 (6)	42	Tube connector	1

Note 1: For type E55 only.

2: ( ) is for E45 & E55.

3: Two or more spacers may be put depending on shipped pumps.

## 7. Troubleshooting

**Caution**



Before working on the pump, disconnect the power cord, depressurize the discharge tubing and drain or flush any residual liquid from the pump head and valves.

Problem	Possible Cause	Corrective Action
Pump does not start	Faulty wiring	Correct wiring
	Improper voltage	Connect to proper voltage source
	Electronic control unit is damaged	Replace control unit
Pump does not prime	Pump stroke length is too short	Operate pump with stroke length set at 100 % until primed. Then set stroke length as needed to obtain desired output.
	Air in suction tubing	Reroute suction tubing to eliminate air trap
	Valve gasket is missing	Install valve gasket
	Valve set assembly direction is wrong.	Reassemble valve set
	Pump is air locked	Prime pump per instructions
	Suction or discharge valve is clogged with foreign matter	Disassemble, inspect, clean
	Ball stuck to valve seat	Disassemble, inspect, clean
Output fluctuates	Suction or discharge valve is clogged with foreign matter	Disassemble, inspect, clean
	Air is trapped in pump	Prime pump per instructions
	Overfeeding	Install injection valve or back pressure valve
	Diaphragm is damaged	Replace diaphragm
	Worn check valves	Replace valve cartridges
Liquid leaks	Fitting or coupling nut is loose	Tighten
	Pump head is loose	Tighten pump head bolts Torque: 2.6 N·m
	Diaphragm is damaged	Replace diaphragm
	O-ring or valve gasket missing	Install o-ring or valve gasket



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